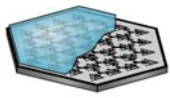


UA LIGHTWEIGHT TECHNOLOGY

Progress report on the University of Arizona NMSD Mirror

Dave Baiocchi
Steward Observatory



Personnel

Dave Baiocchi - Metrology, System Assembly

Roger Angel

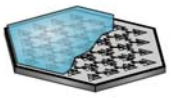
Jim Burge - Principal Investigator

Scott DeRigne - Project Manager

Brian Cuerden - Project Engineer

Steve Bell - Electronics

Gil Rivlis - Actuator Software



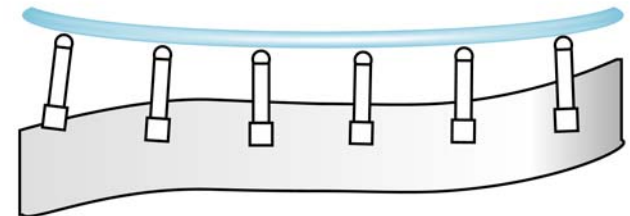
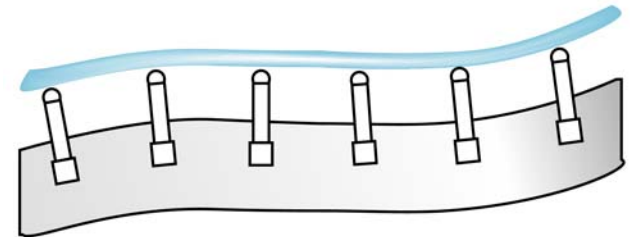
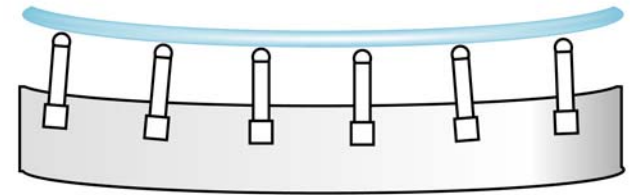
A Solution for Lightweight Mirrors

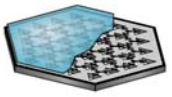
Components

1. Glass facesheet
2. Position actuators
3. Lightweight reaction structure

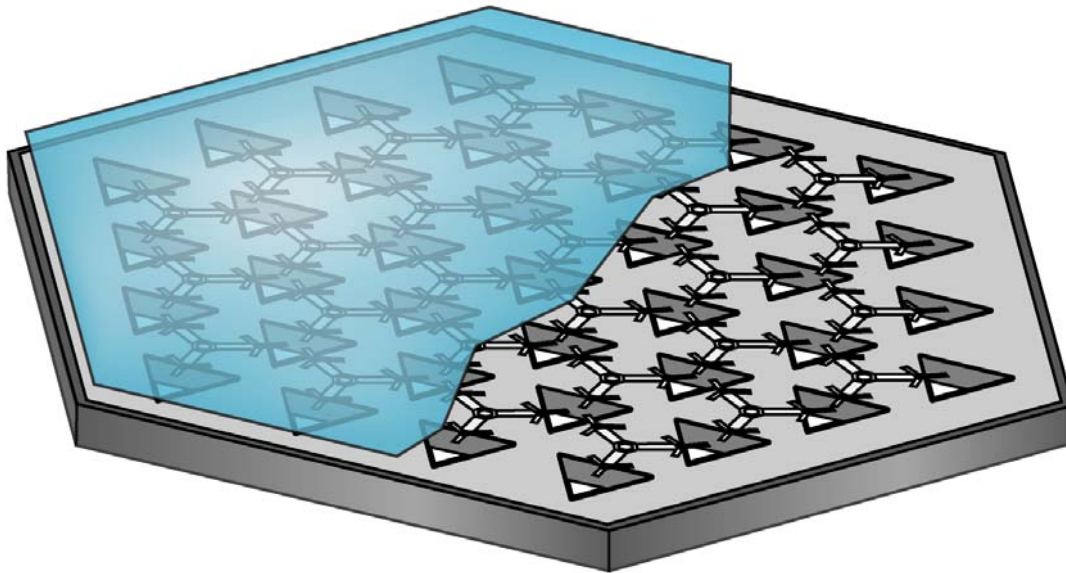
Operation

1. Ideal Shape
2. Structure deforms, membrane follows
3. Actuators correct figure



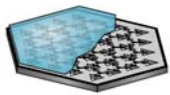


The University of Arizona NGST Mirror System Demonstrator (NMSD)



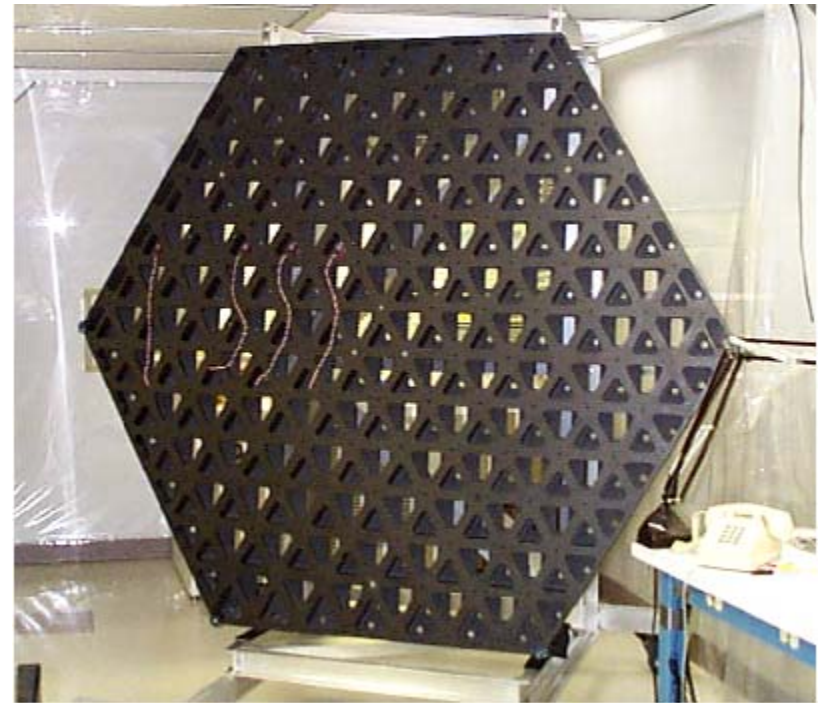
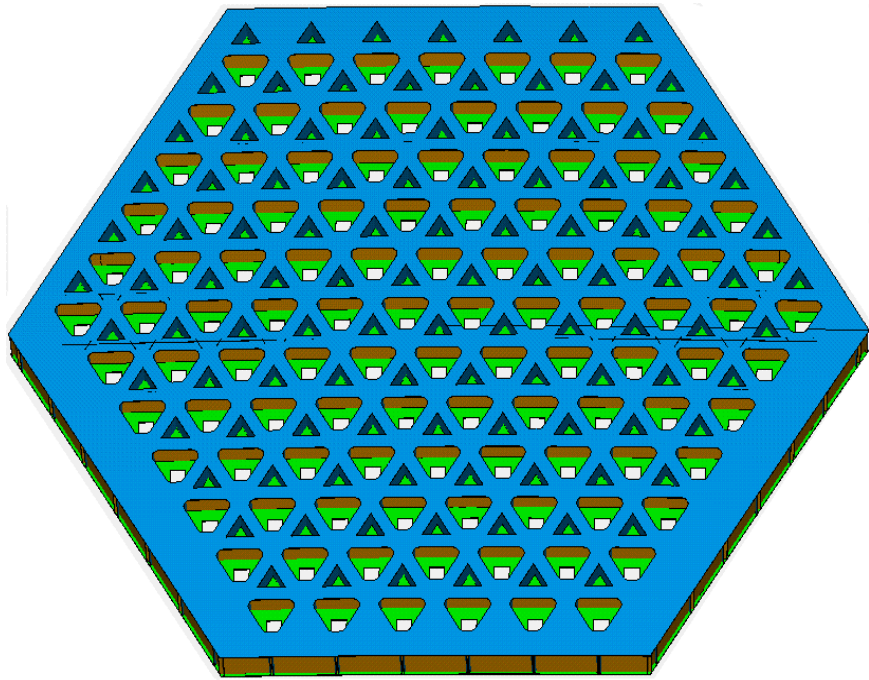
- 2 meters in diameter
- 2 mm thick facesheet
- 166 actuators
- 35K operation
- Designed for launch
- 13 kg/m²

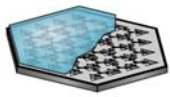
86 pounds



NMSD Reaction Structure

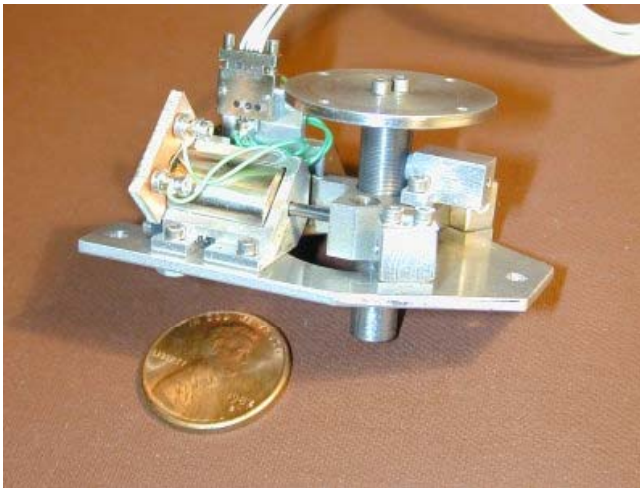
Designed by UA. Fabricated at Composite Optics, Inc (COI).



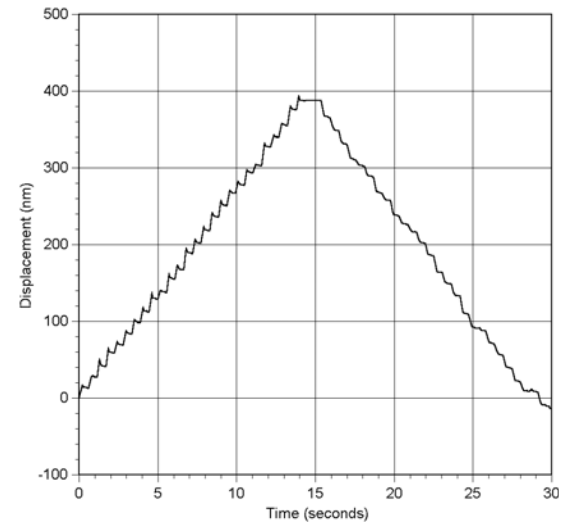


NMSD Actuators

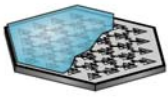
Invented at the University of Arizona
40 grams, 10 nm step size, cryo operation



Actuator



Data



Typical Glass Fabrication Process



Polish convex side.



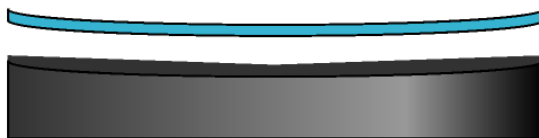
Fabricate blocking body.
Figure is not critical.



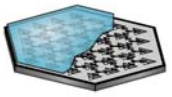
Attach glass to blocking body.



Generate glass to thickness.
Grind and polish.



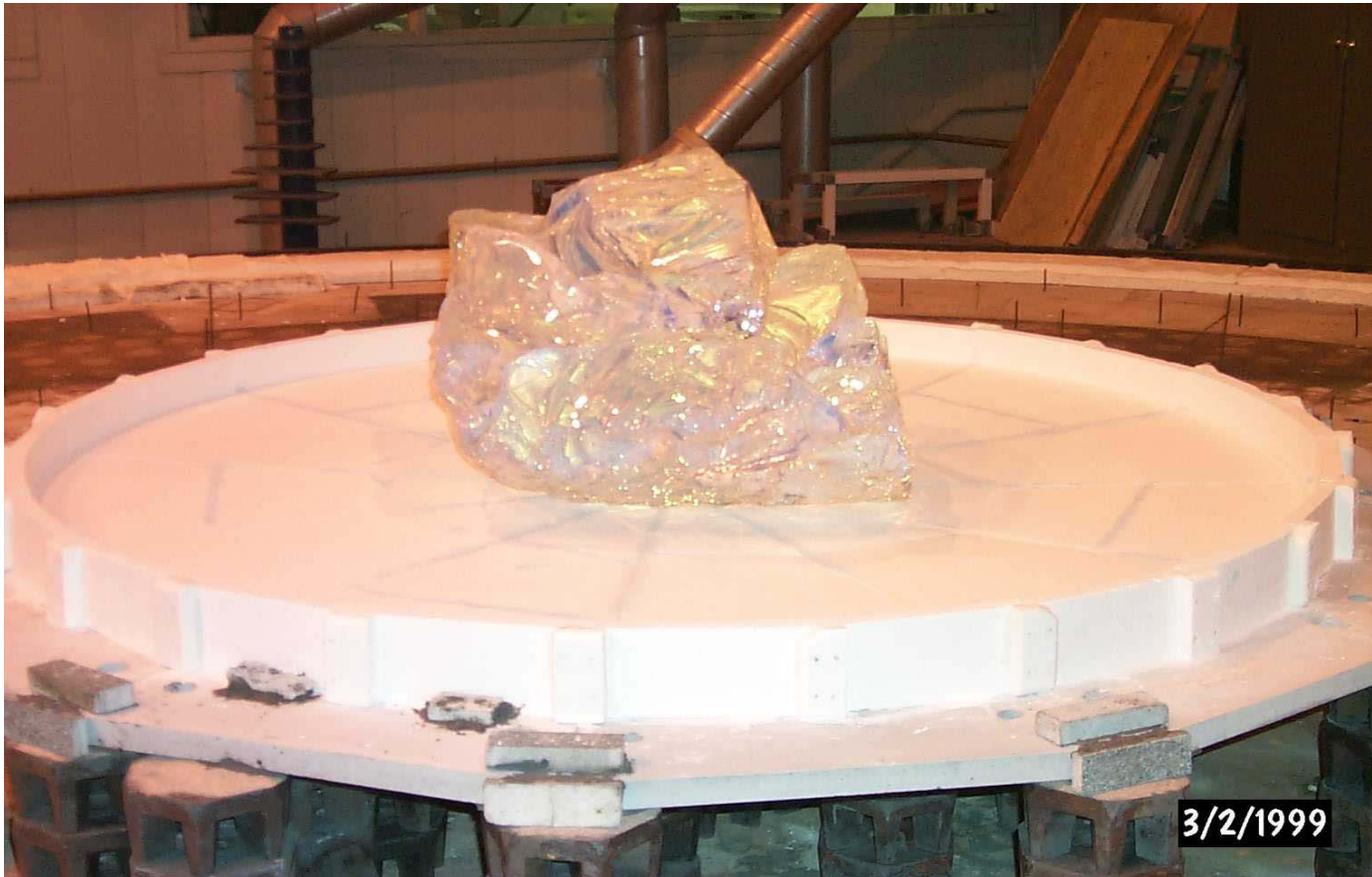
Remove glass from blocking body.
("De-block glass.")

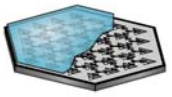


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NMSD Glass Fabrication

Cast at the Steward Mirror Lab





NMSD Glass Fabrication

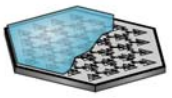


Convex side

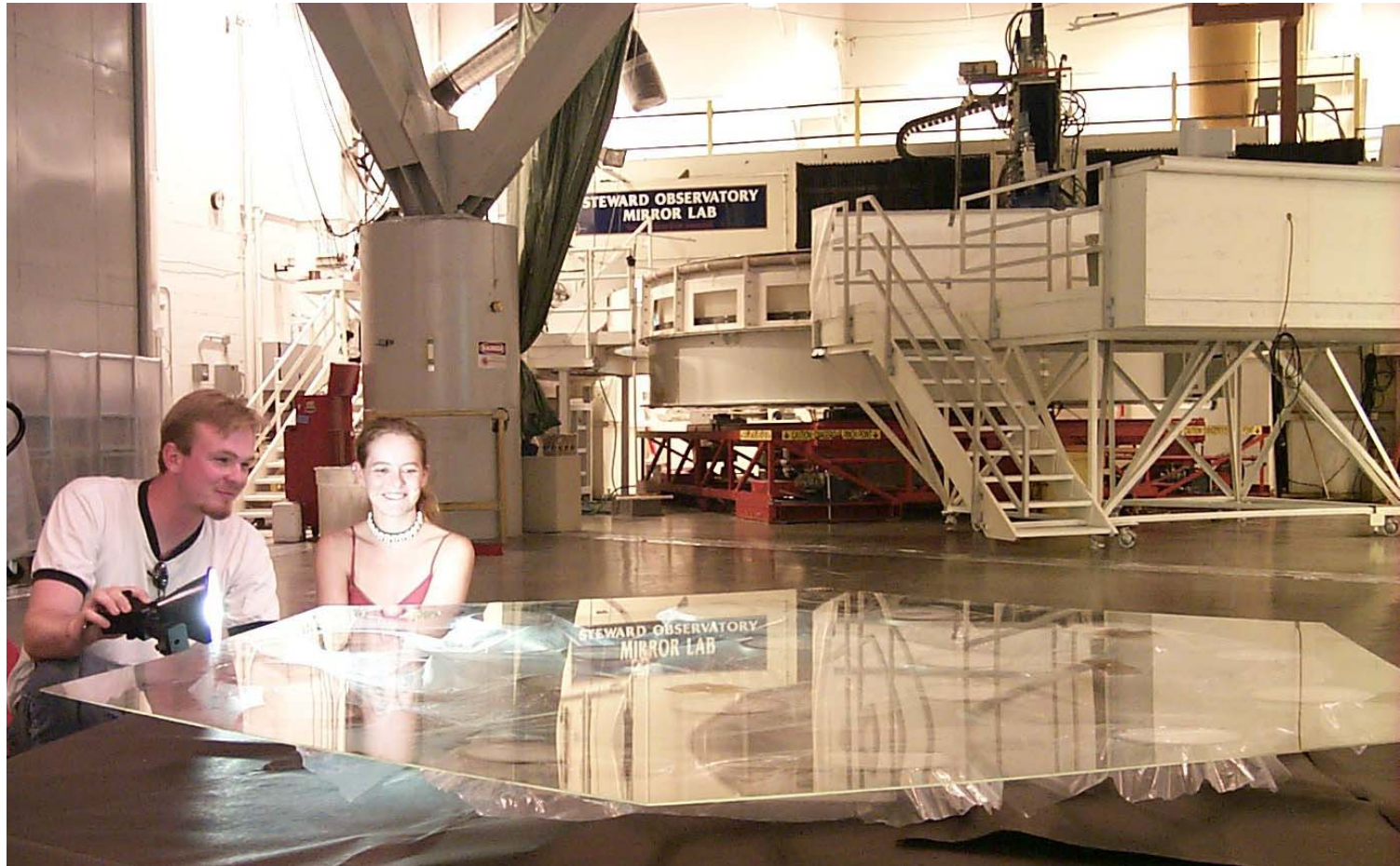
Fabricated at the
Optical Sciences Center

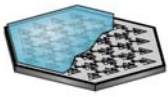


Concave side



NMSD Glass Meniscus

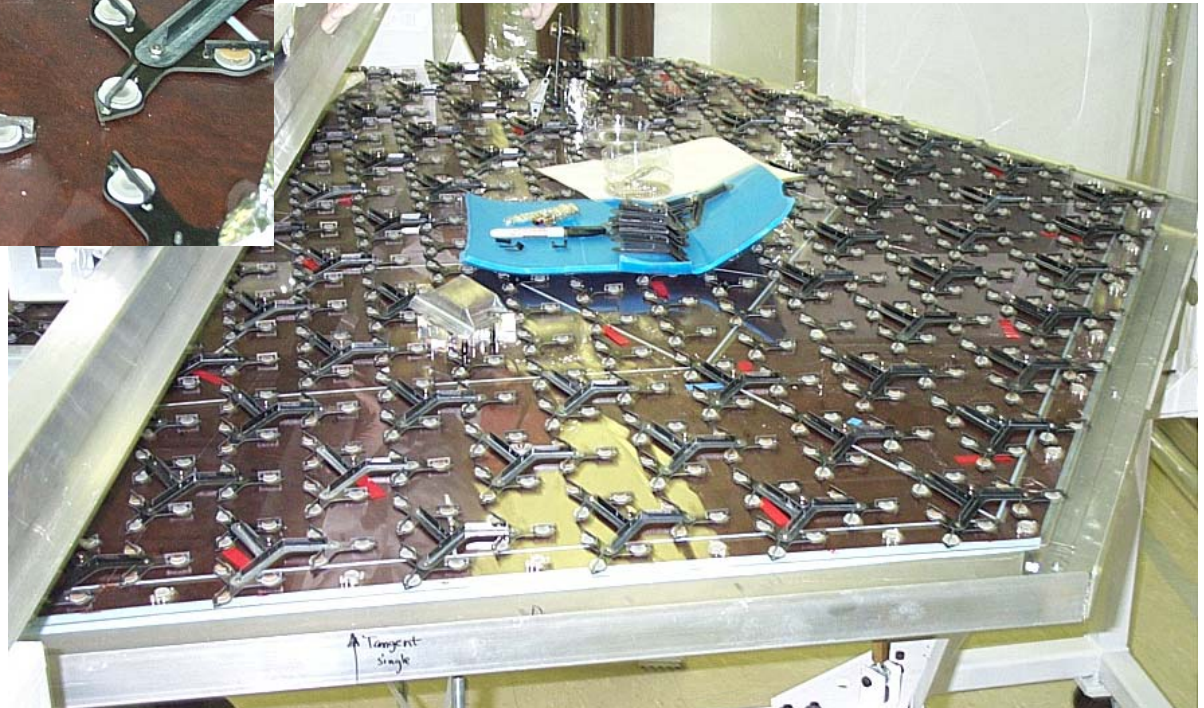


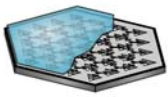


Loadspreader Bonding

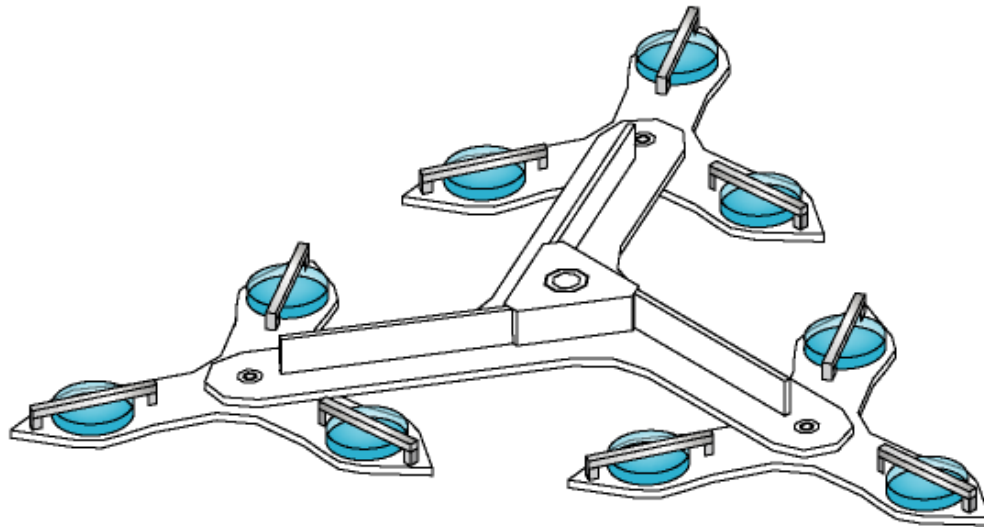


- 9 point whiffle tree
- 1166 glass buttons
- Courtaulds PR1564



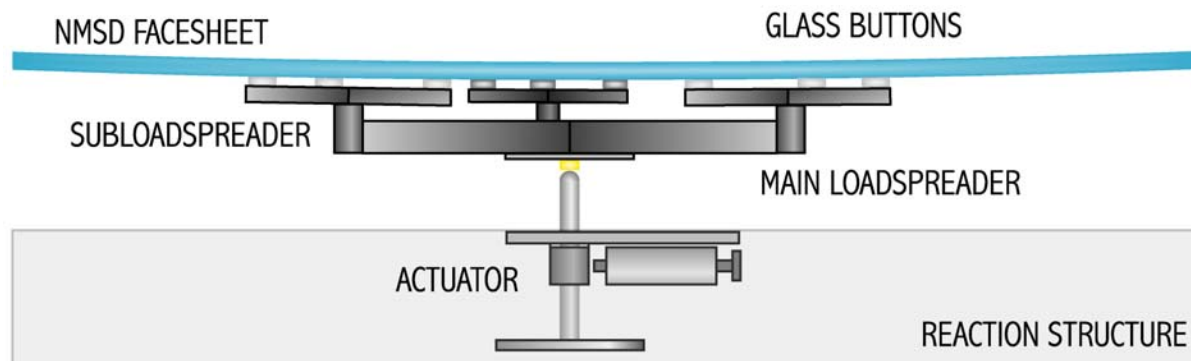


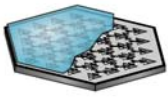
Loadspreader Dynamics



The loadspreaders regulate the forces on the glass

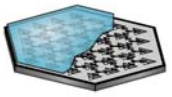
- 0.1 lb upward force
- 0.3 lb downward force



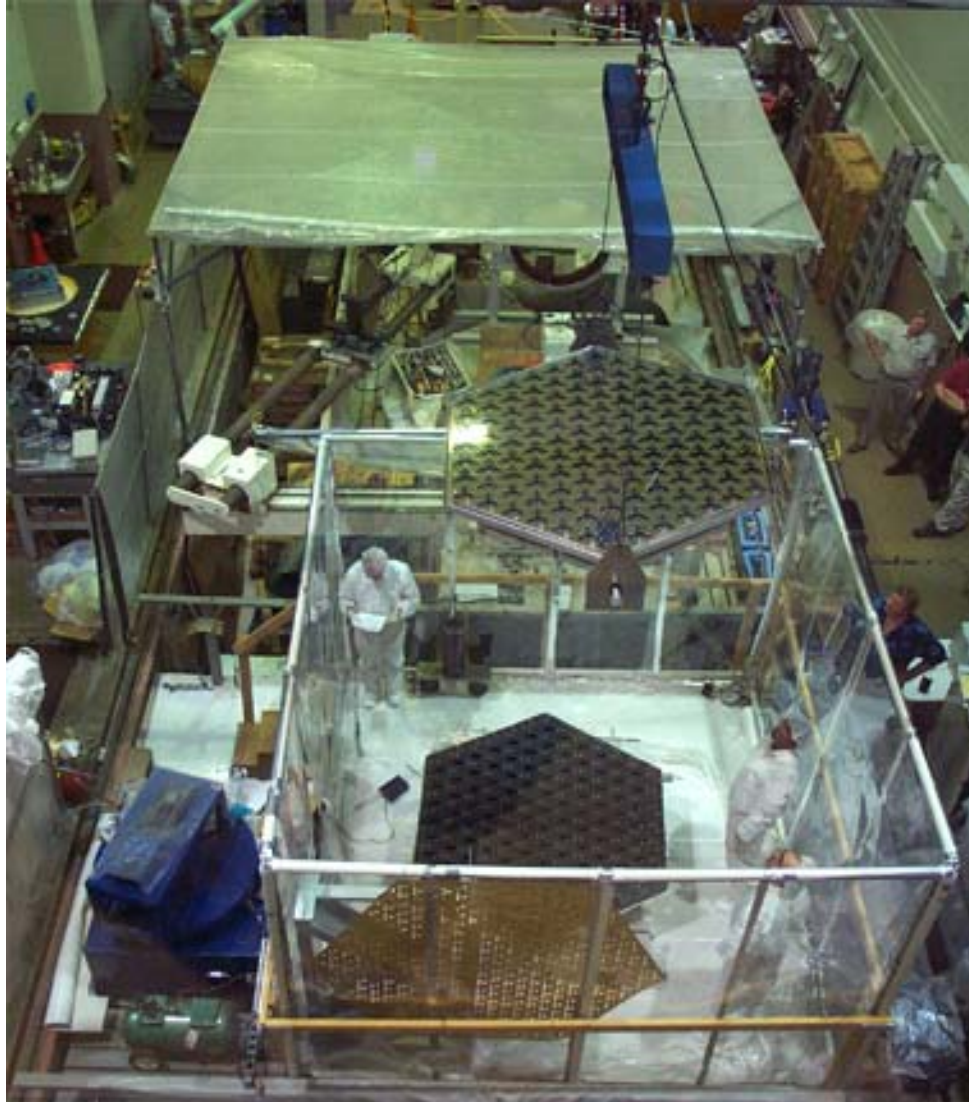


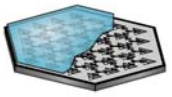
Preparing for Coating



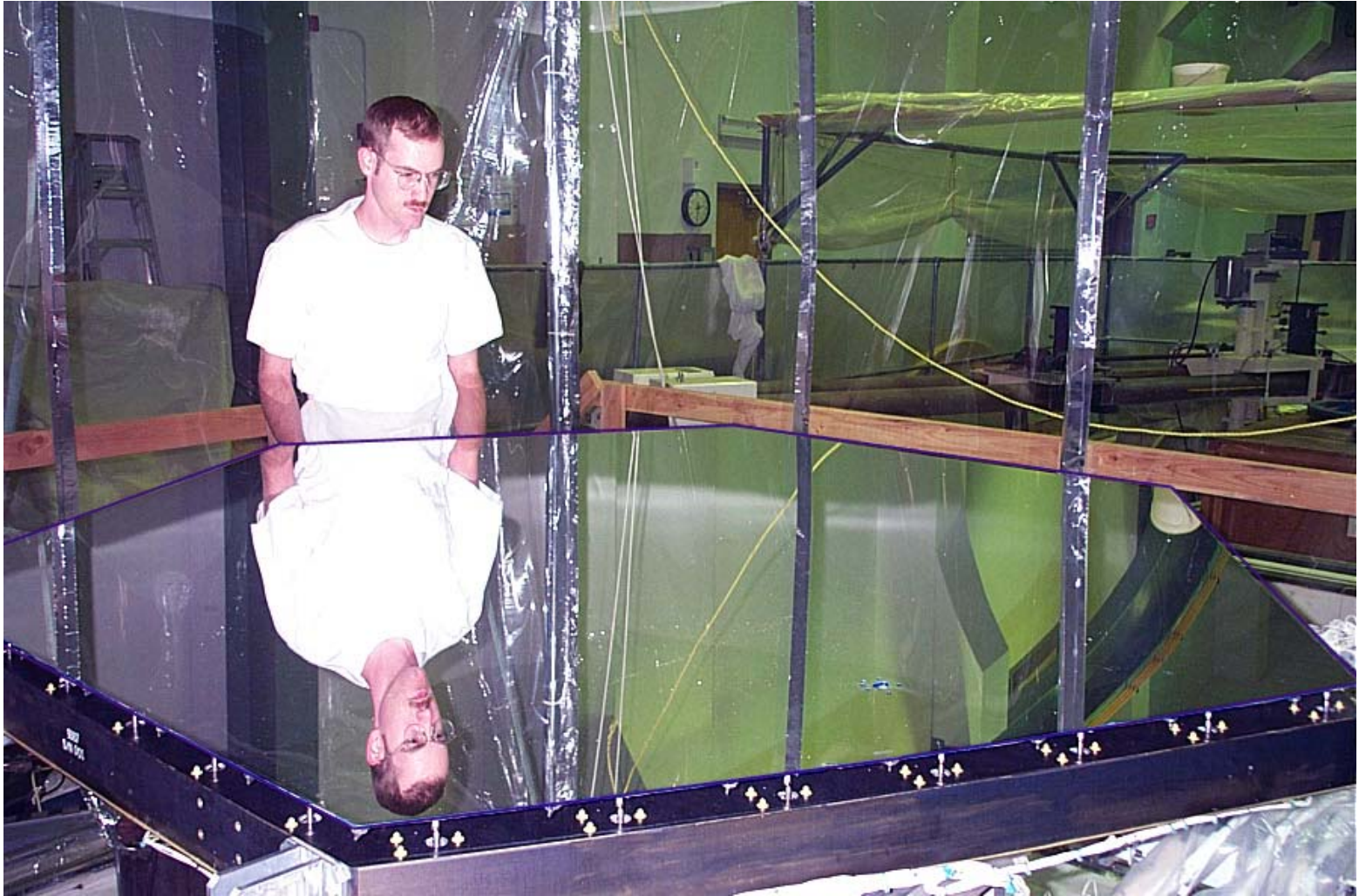


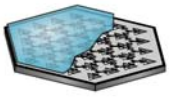
System Assembly



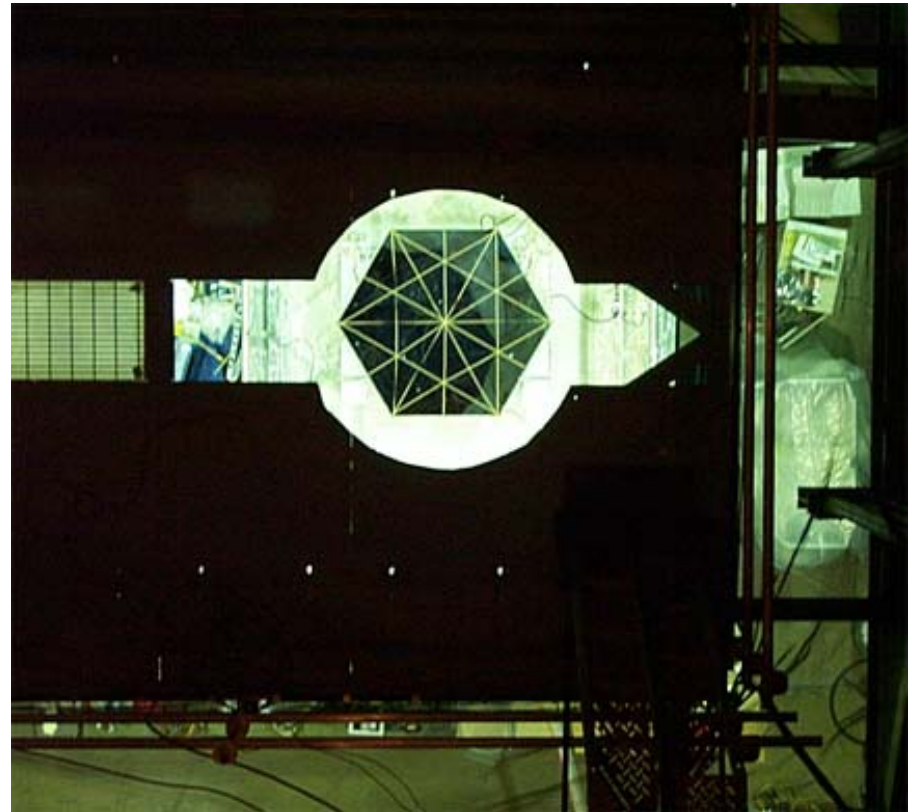
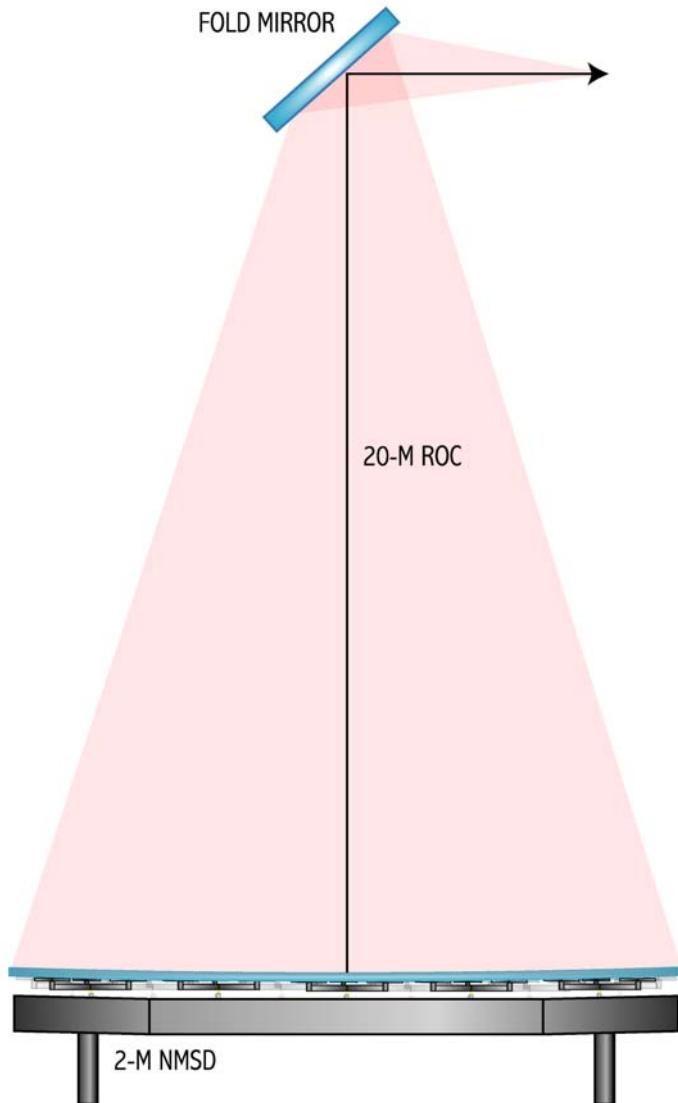


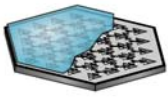
Assembled NMSD Mirror





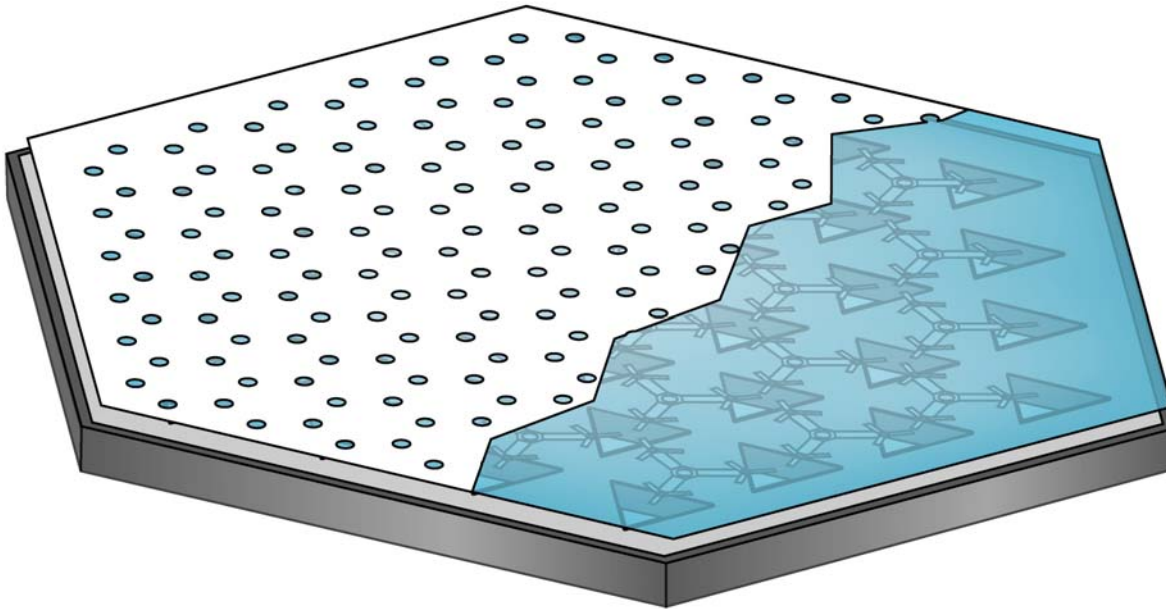
System Testing





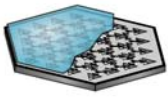
System Testing

Metrology - The Hartmann Test



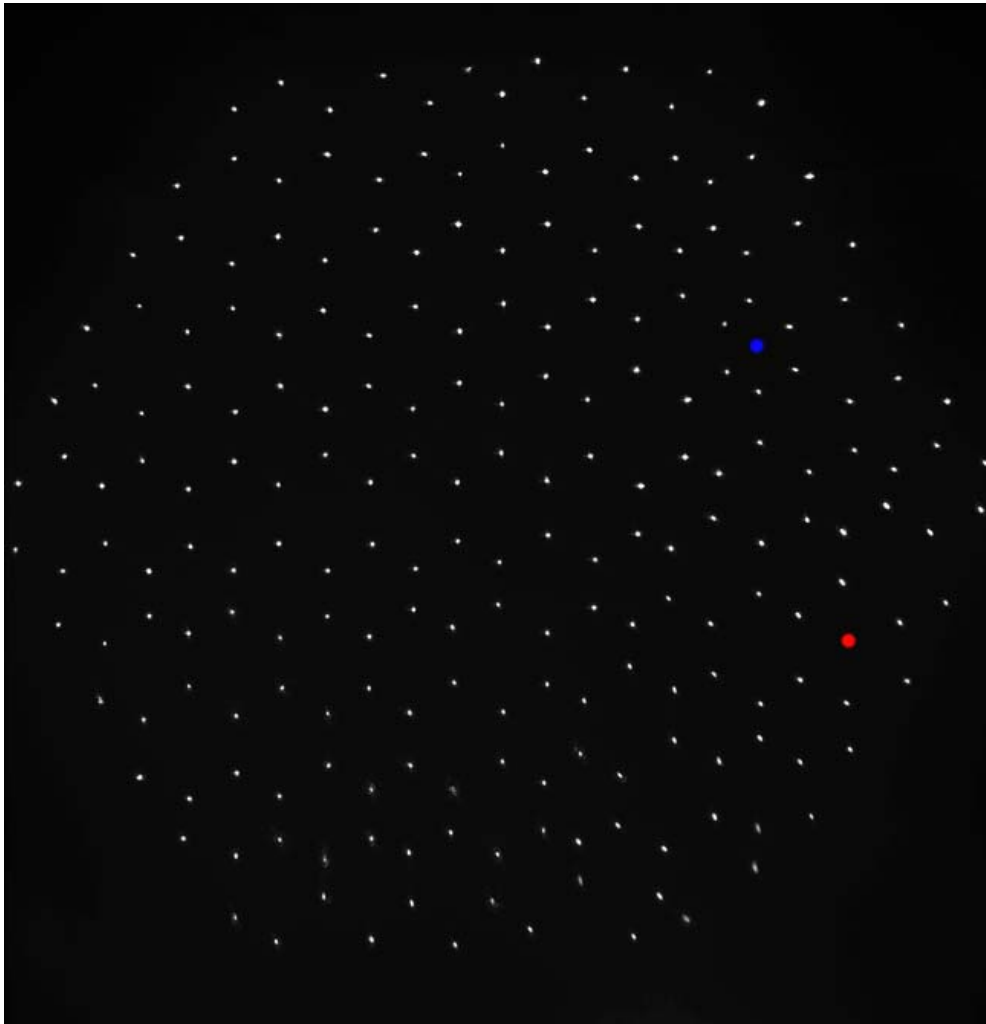
Mask has 216 holes

Hartmann test has
a large dynamic
range



System Testing

Metrology - The Hartmann Test

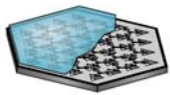


Each actuator is surrounded
by 6 spots

Blue - too low

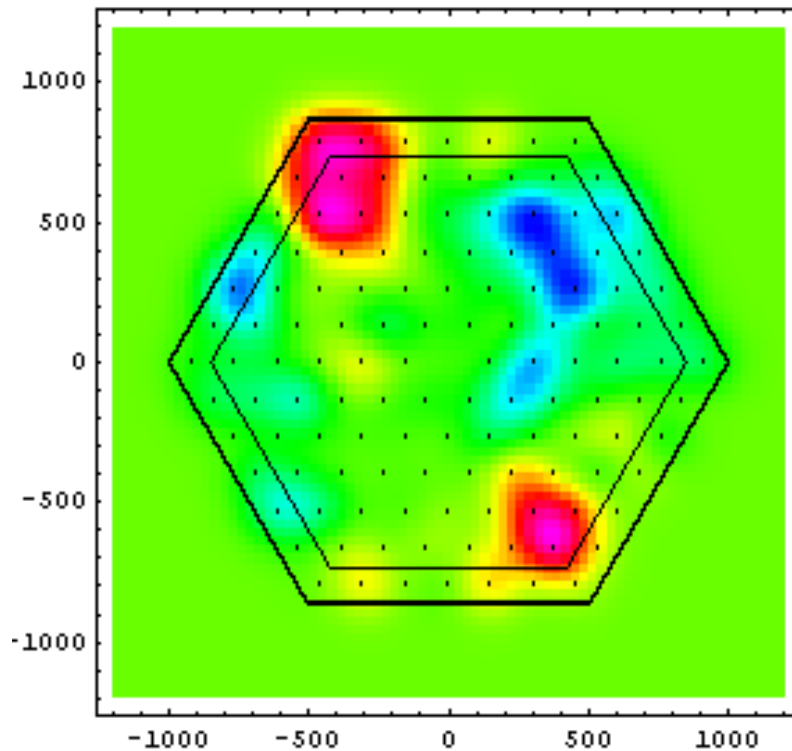
Red - too high

Algorithm calculates the
surface figure

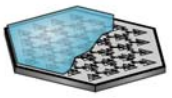


Surface Figure

Current Surface Map

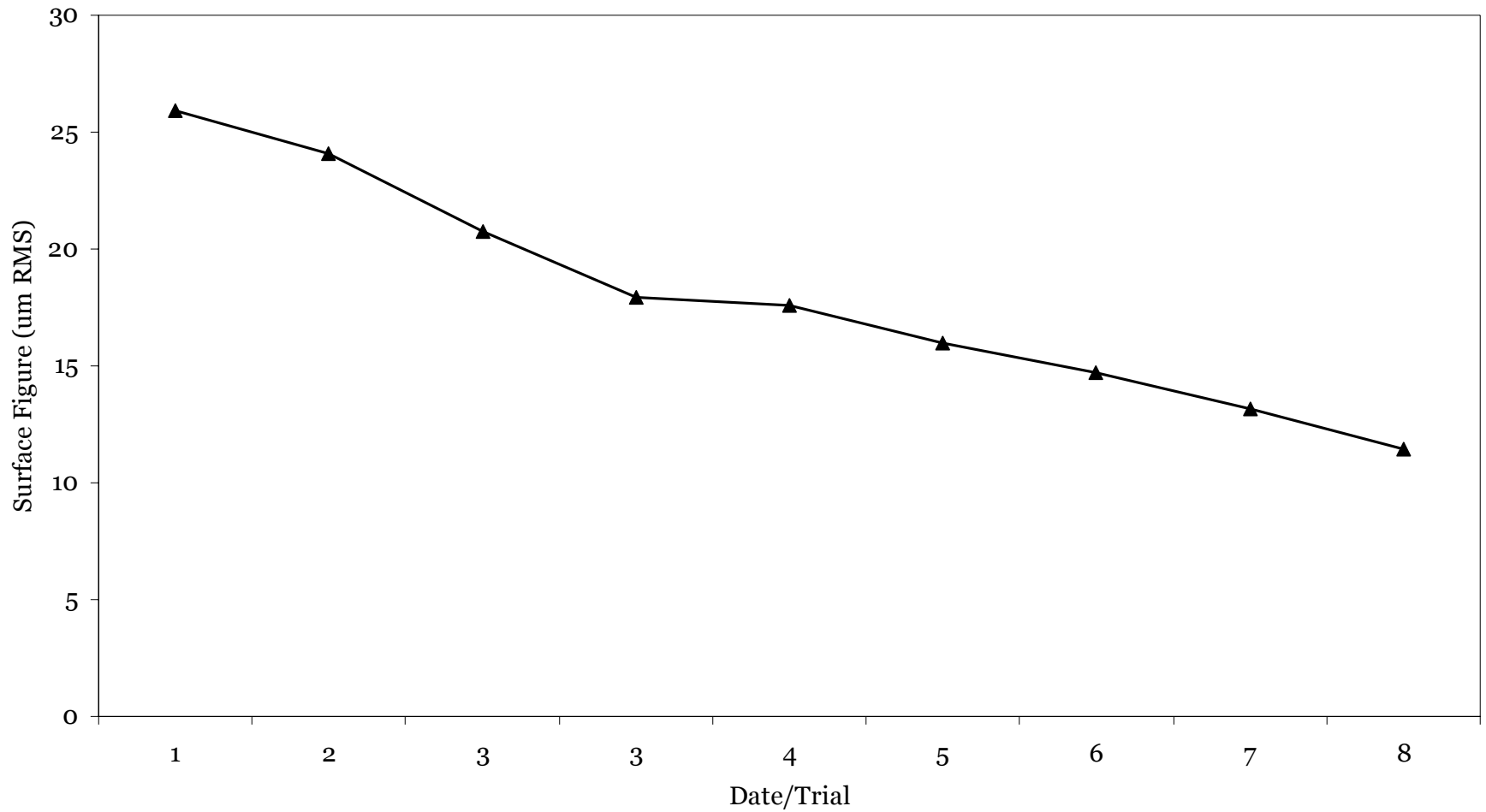


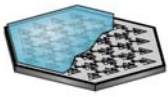
11.4 microns rms surface
61.3 microns PV surface



Progress

The figure is converging!





Current Issues

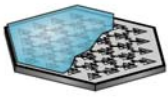
Surface accuracy depends on the actuators

Hardware issues

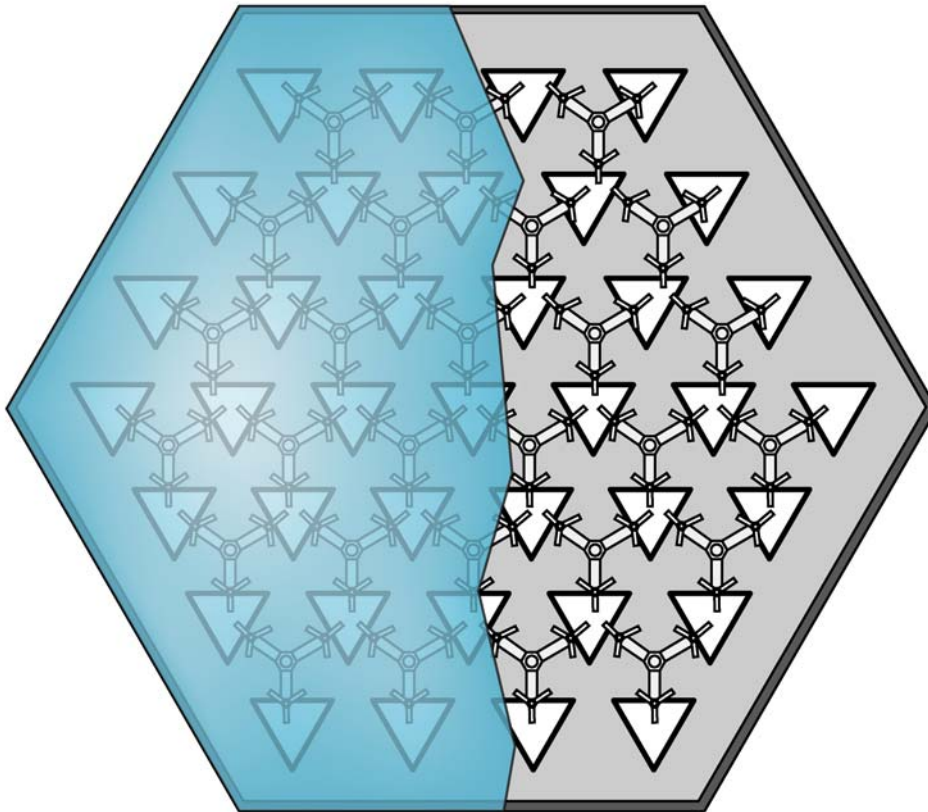
- Recalibrating the actuator-drive electronics
- Characterizing actuator performance

Solutions

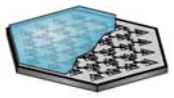
- Real-time algorithm tracks actuator performance and compensates for any problems



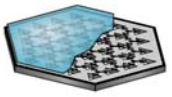
Conclusion



- The mirror is assembled.
- We are working to improve the ambient figure.
- Valuable lessons for future mirrors.
- No “showstoppers”.

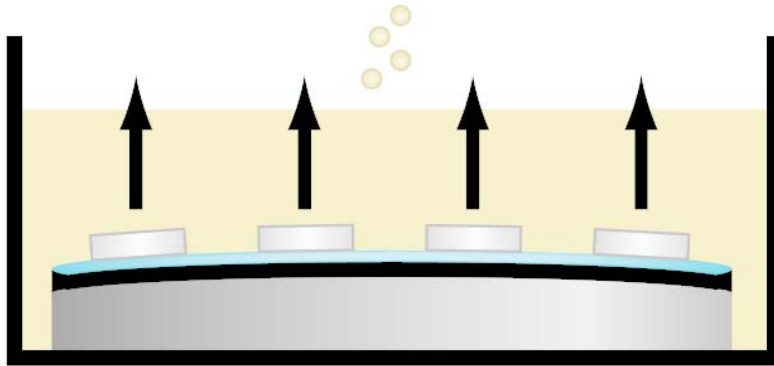


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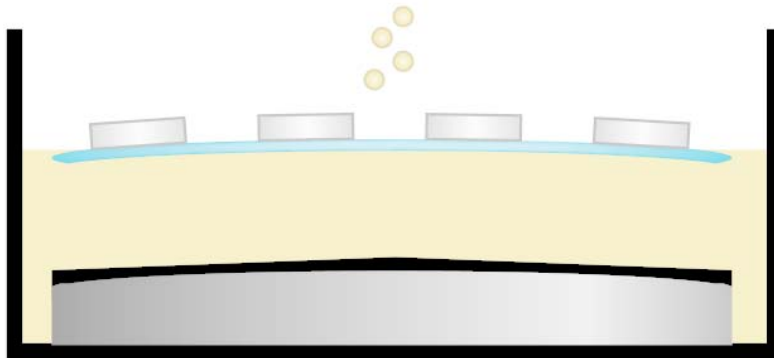


NMSD Glass Deblocking

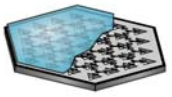
Hot Oil-Bath Technique



Floats attached to glass



Pitch softens and
glass floats to the surface

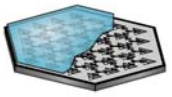


NMSD Glass Deblocking

Hot Oil-Bath Technique



- Very safe
- 30W motor oil
- 250° F
- 18 floats



NMSD Glass Deblocking Handling



Degreasing/Cleaning

Lifting the deblocked glass.

